

CLAIMS:

1. A turbogenerator, comprising:

a compressor configured to compress a fuel oxidizer;

a combustor connected to an exhaust of the compressor and configured both to receive  
5 the fuel oxidizer and a fuel and to combust the fuel and the fuel oxidizer into a combusted  
gas;

a fuel supplier configured to control fuel droplet sizes of the fuel supplied into the  
combustor to prevent flameout of the turbogenerator;

a turbine attached to an exhaust of said combustor and configured to convert heat  
10 from the combusted gas into rotational energy;

a motor/generator configured to convert said rotational energy into electrical energy;  
and

a common shaft connecting said turbine, said compressor, and said motor/generator,  
wherein said common shaft is configured to rotate said turbine, said compressor, and  
15 said motor/generator.

2. The turbogenerator of Claim 1, further comprising:

a catalytic reactor downstream of said turbine configured to reduce unburned  
hydrocarbons in said combusted gases.

3. The turbogenerator of Claim 1, further comprising:

a recuperator configured to transfer heat from exhaust gases downstream of said  
compressor to the intake fuel oxidizer.

4. The turbogenerator of Claim 1, further comprising:

a power controller configured to control at least one of a turbine temperature and a  
25 turbine speed.

5. The turbogenerator of Claim 4, wherein the power controller is configured to  
control at least one of a supply pressure of the fuel supplier, a first fuel-injection mechanism  
configured to inject the fuel into the combustor via a variable orifice, a second fuel-injection

mechanism configured to inject fuel via separate fuel injectors, a fuel-heating mechanism configured to heat the fuel, a fuel-cooling mechanism configured to cool the fuel, and an electric field inside the combustor.

6. The turbogenerator of Claim 1, further comprising:

5 a power controller configured to control a current between the motor/generator and an electrical load.

7. The turbogenerator of Claim 6, wherein the electrical load comprises at least one of:

10 a load-line power converter connected to a power grid;  
an energy storage device connected to at least one battery via a battery power converter; and  
a dynamic brake resistor.

8. The turbogenerator of Claim 7, wherein the dynamic brake resistor is configured to be selectively applied to remove power from the motor/generator.

15 9. The turbogenerator of Claim 6, wherein the power controller comprises:

a bi-directional generator power converter connected between said motor/generator and a DC bus and configured to convert AC power from said motor/generator for application to said DC bus and to convert DC power from said DC bus for application to said motor/generator.

20 10. The turbogenerator of Claim 9, wherein the power controller further comprises:

a speed control loop responsive to a measured value related to a rotational speed of said common shaft and configured to control said rotation speed at a predetermined speed set point by operating said bi-directional generator power converter to apply power from said motor/generator to said DC bus and from said DC bus to said motor/generator.

25 11. The turbogenerator of Claim 1, wherein the compressor comprises:

an air blast unit configured to mix the fuel droplets in an air blast.

12. The turbogenerator of Claim 1, wherein the fuel supplier comprises:  
at least one fuel injector.

13. The turbogenerator of Claim 12, wherein the at least one fuel injector comprises:  
at least one variable orifice.

14. The turbogenerator of Claim 13, wherein the at least one variable orifice is  
configured to inject the fuel into the combustor at varying entry angles to change a degree of  
fuel/fuel-oxidizer mixing.

15. The turbogenerator of Claim 1, wherein the fuel supplier comprises:  
at least two fuel injectors with orifices differing in at least one of an opening size and  
a shape.

16. The turbogenerator of Claim 1, wherein the fuel supplier comprises:  
a mechanism configured to heat the fuel.

17. The turbogenerator of Claim 1, wherein the fuel supplier comprises:  
a mechanism configured to cool the fuel.

18. The turbogenerator of Claim 1, wherein the fuel supplier comprises:  
a pre-mixer configured to supply prior to the compressor at least a part of said fuel to  
the fuel oxidizer.

19. The turbogenerator of Claim 1, wherein the fuel supplier comprises:  
a fuel conduit configured to supply said fuel to the compressor.

20. The turbogenerator of Claim 1, wherein the fuel supplier is configured to adjust a  
fuel/fuel-oxidizer ratio to control a turbine temperature.

21. The turbogenerator of Claim 1, wherein the combustor comprises:  
an electric field existing inside the combustor and configured to charge the fuel droplets.

22. The turbogenerator of Claim 1, wherein the combustor comprises:  
a catalytic combustor configured to combust unreacted hydrocarbons in the combustion gas on catalytic surfaces therein.

23. A method for controlling a turbogenerator, comprising:  
compressing a fuel oxidizer;  
supplying to the fuel oxidizer a fuel with a controllable fuel droplet size to prevent flameout of the turbogenerator;  
combusting the fuel and the fuel oxidizer to produce combusted gases whose expulsion through a turbine generates turbine rotational energy;  
applying a rotational resistance to the turbine via a motor/generator, said motor/generator converting the turbine rotational energy into an electrical energy; and  
controlling a rotational speed of the turbine by varying a degree of the compressing, supplying, combusting, and applying steps.

24. The method of Claim 23, wherein the step of compressing comprises:  
supplying an air blast of the fuel oxidizer.

25. The method of Claim 23, wherein the step of supplying comprises:  
injecting the fuel through at least one variable orifice configured to vary entry angles of the fuel droplets to change a degree of fuel/fuel-oxidizer mixing.

26. The method of Claim 23, wherein the step of supplying comprises:  
injecting the fuel through orifices differing in at least one of an opening size and a shape.

27. The method of Claim 23, wherein the step of supplying comprises:

injecting the fuel into a combustor having an electric field.

28. The method of Claim 23, wherein the step of supplying further comprises:  
heating the fuel prior to said step of combusting.

29. The method of Claim 23, wherein the step of supplying further comprises:  
cooling the fuel prior to said step of combusting

30. The method of Claim 23, wherein the step of combusting comprises:  
varying a fuel/fuel-oxidizer ratio to control a turbine temperature.

31. The method of Claim 23, wherein the step of applying comprises:  
introducing an electrical load onto the motor/generator.

32. The method of Claim 31, wherein the step of introducing comprises:  
introducing at least one of a load-line power converter connected to a power grid, an  
energy storage device connected to at least one battery via a battery power converter, and a  
dynamic brake resistor as said electrical load.

33. The method of Claim 31, wherein the step of introducing comprises:  
removing electrical power from the motor/generator.

34. The method of Claim 31, wherein the step of introducing comprises:  
adding electrical power to the motor/generator.

35. The method of Claim 23, wherein the step of controlling comprises:  
controlling the rotational speed to a predetermined speed set point.

36. A power generation and distribution system comprising:  
a turbogenerator, including,  
a compressor configured to compress a fuel oxidizer,

a combustor connected to an exhaust of the compressor and configured both to receive the fuel oxidizer and a fuel and to combust the fuel and the fuel oxidizer into a combusted gas,

a fuel supplier configured to control fuel droplet sizes of the fuel supplied into the combustor to prevent flameout of the turbogenerator,

a turbine attached to an exhaust of said combustor and configured to convert heat from the combusted gas into rotational energy,

a motor/generator configured to convert said rotational energy into electrical energy, and

a common shaft connecting said turbine, said compressor, and said motor/generator, said common shaft configured to rotate said turbine, said compressor, and said motor/generator; and

an electrical load connected to the turbogenerator.

37. The system of Claim 36, further comprising:

a power controller configured to control at least one of a turbine temperature, a turbine speed, and a current between the motor/generator and the electrical load.

38. The system of Claim 36, wherein the electrical load comprises at least one of:

a power grid; and

an energy storage device.

39. The system of Claim 38, wherein the power grid includes a load-line power converter.

40. The system of Claim 38, wherein the energy storage device includes a battery power converter.